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OPERATION & SERVICE MANUAL

FOR

NLS MODEL 155 PRINTER

non-linear systems, inc.

non linear
systems, inc.

DEL MAR, CALIFORNIA

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June, 1962

OPERATION & SERVICE MANUAL

FOR

NLS MODEL 155 PRINTER

This Manual is to be accompanied by the Hewlett-Packard Printer

Operation & Service Manual

Mechanism Type 130

NON-LINEAR SYSTEMS, INC.

Del Mar, California

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ADDENDUM:

Hewlett-Packard Printer Mechanism Type 130
Operation and Service Manual
Effective on Printer S/N 155.16 and subsequent.

SPECIFICATIONS

COLUMN CAPACITY:	11 columns (11 digits per line plus one or more fixed decimal points).
PRINT RATE:	5 lines per second or 3300 characters per minute, maximum.
NUMBER WHEELS:	12 positions having numerals 0 through 9, minus sign, and a blank.
SYMBOL WHEELS:	12 positions, having symbols as required for polarity, function, or external data.
DATA ENTRY:	Through individual wires, one for each position of each wheel, brought to female connector. Mating connectors and/or cables are furnished.
DATA SOURCE:	Stepping switches, relays, or voltage change (-1.5V print, -30V no print) as in the NLS Series 20 Digital Instruments.
INPUT CURRENT:	2 milliamperes per selected digit.
PRINT COMMAND:	An external contact closure, or a negative pulse (-15V to -30V, 1 ma.), 10 millisecond minimum width. Manual control by a momentary contact toggle switch. Print commands during scan and print action have no effect.
PAPER REQUIRED:	Standard 3-inch roll or folded paper tape.
LINE SPACING:	6.4 lines per inch. Single space, double space, or no print manually selectable on front panel.
POWER:	115V, 50/60 cps standard. Maximum printing rate is 4/second with 50 cps power. 5/second printing rate with 50 cps power, and other voltages and frequencies available on special order. Power consumption is approximately 35VA.
DIMENSIONS:	19" wide, 10½" high, 16-9/16" deep behind panel. Required rack depth is 19 inches.
NET WEIGHT:	30 lbs.

DESCRIPTION AND INSTALLATION

1.0 GENERAL DESCRIPTION

The NLS Model 155 Digital Recorder is a fast electro-mechanical printer which prints 11 column numerical data at rates up to 5 lines per second. The Model 155 is ideally suited for recording rapidly changing data such as flow rate, pressure, voltage, current, frequency and other information in decimal form. The Model 155 makes a permanent printed record of data furnished by digital voltmeters, stepping switches, relay matrices, and other data-gathering systems using a 10-line code. The print wheels have 12 positions. Formats are explained on Page 6.

Data entry to the 155 is through a separate wire for each print wheel symbol (12 wires per wheel). These wires are brought out to connectors at the rear of the instrument.

In addition to this manual, the following items are included with your 155 Digital Recorder:

1. Printer Mechanism Manual (covering mechanical portion of the 155).
2. Service Kit (packed in storage compartment).
3. Folded paper tape (also packed in storage compartment).
4. Pin for use with rolled paper tape (taped to bottom of paper compartment).
5. Inked ribbon (installed).

2.0 50-CYCLE OPERATION

The 155 will operate from a 50-cycle source at slightly reduced speed. The normal maximum of five prints per second will be reduced to four. A special motor pinion gear is available which corrects for the reduced motor speed from a 50-cycle source. Refer to the Printer Mechanism Manual at the end of this document for modification instructions.

3.0 OPERATION WITH NLS DIGITAL VOLTMETERS AND INPUT SCANNERS

1. Connect the printer to the digital instrument and input scanner, if used, with the cable provided. Be careful not to interchange J-1, J-2, and J-3.

2. Connect the power cord to a source of 115-volt 60 cps (unless a different voltage or frequency has been specified) and turn the POWER switch ON. The POWER indicator lamp should light.

3. After the digital instrument and input scanner have been set to the desired recording mode, as described in the applicable handbooks, turn the printer RECORD switch ON. The RECORD lamp should light, and the printer will print on receipt of a command signal from the digital instrument. A printing may also be obtained manually by momentarily pressing down the RECORD switch.

3.1 Standard NLS Model 155 Printer Formats

FORMAT #1 - For 4-digit digital voltmeters: $YYYYS_1XXXX.Z$

FORMAT #2 - For 5-digit digital voltmeters: $YYYYS_1XXXXX.Z$

FORMAT #3 - For 4-digit volt-ohm-ratio meters or voltmeter ratiometers, such as NLS Models V34, M24, V24: $YYYYS_1S_2XXXX.Z$

Since Format 3 is the most frequently used, its symbols are shown in Figure 1. Users of other formats will find a copy of the applicable drawing supplied with the instrument.

FORMAT #4 - For 5-digit digital voltmeters and ratiometers such as the Model V35: $YYYS_1S_2XXXXX.Z$

3.2 Explanation of Model 155 Printer Formats

Y columns are spares; they can record channel number (if an NLS Input Scanner is used) or other data in contact closure form.

X columns record digital instrument readings.

Z columns record the power of 10 multiplier to locate the decimal point: .2 means move the decimal point two places to the left, etc. This column extends printer utilization since fixed decimal points do not require a separate column, while each floating decimal point position would.

Symbols that can print in each column. 12th position of each print wheel is blank.

Y	Y	Y	Y	S_1	S_2	X	X	X	X	.Z
1	1	1	1	+	V	1	1	1	1	.1
2	2	2	2	-	~	2	2	2	2	.2
3	3	3	3	A	C	3	3	3	3	.3
4	4	4	4	P	A	4	4	4	4	.4
5	5	5	5	T	T	5	5	5	5	.5
6	6	6	6	r	H	6	6	6	6	.6
7	7	7	7	R	L	7	7	7	7	.7
8	8	8	8	>	+	8	8	8	8	.8
9	9	9	9	K	-	9	9	9	9	.9
0	0	0	0	~	R	0	0	0	0	.0
-	-	-	-	*	~	-	-	-	-	.-

Symbol columns S_1 and S_2 are normally used for the following information:

FORMATS 1 and 2 -- + or - for DC voltage or ratio
A for AC voltage
K for kilohms

FORMATS 3 and 4 -- +V or -V for DC voltages
+R or -R for ratio
AC for AC voltage
K~ for kilohms

SYMBOLS

COLUMN										
11	10	9	8	7	6	5	4	3	2	1
\	1	1	1	+	V	1	1	1	1	1
2	2	2	2	-	∽	2	2	2	2	2
3	3	3	3	A	C	3	3	3	3	3
4	4	4	4	P	A	4	4	4	4	4
5	5	5	5	T	T	5	5	5	5	5
6	6	6	6	r	H	6	6	6	6	6
7	7	7	7	R	L	7	7	7	7	7
8	8	8	8	>	+	8	8	8	8	8
9	9	9	9	K	—	9	9	9	9	9
0	0	0	0	~	R	0	0	0	0	0
—	—	—	—	*	~	—	—	—	—	—
							Fixed Decimal→●			

PIN CONNECTIONS

COLUMN										
11	10	9	8	7	6	5	4	3	2	1
50	26	25	1	50	26	25	1	26	25	1
49	27	24	2	49	27	24	2	27	24	2
48	28	23	3	48	28	23	3	28	23	3
47	29	22	4	47	29	22	4	29	22	4
46	30	21	5	46	30	21	5	30	21	5
45	31	20	6	45	31	20	6	31	20	6
44	32	19	7	44	32	19	7	32	19	7
43	33	18	8	43	33	18	8	33	18	8
42	34	17	9	42	34	17	9	34	17	9
41	35	16	10	41	35	16	10	35	16	10
40	36	15	11	40	36	15	11	36	15	11
39	37	14	12	39	37	14	12	37	14	12
J-3 CONNECTOR				J-2 CONNECTOR				J-1 CONNECTOR		

Figure 1. FORMAT #3.(See format drawing supplied with printer for other formats.)

4.0 OPERATION WITH EXTERNAL EQUIPMENT

4.1 Data Programming

To program a print wheel symbol externally, connect Pin 38 of J-1, J-2, or J-3 to the appropriate input terminal as indicated in Figure 2 or the format drawing supplied with the printer. This method may be used with relay matrices, stepping switches, and other contact closure systems. See Figure 2.

4.2 Column Selection

To activate a previously unused column, remove the printer cover and add a jumper across the appropriate terminals on the board at the rear of the printer. Similarly, if an active column is no longer needed, either connect an external jumper from pin 38 of J-1, J-2, or J-3 to the pin corresponding to the blank position of the column in question, or remove the appropriate jumper from the terminals in the rear of the printer and manually set the print wheel to the blank position. See Figure 3.

4.3 Print Command

The external system must provide a print command pulse to initiate the printing cycle each time a number is to be printed. This pulse must be negative, 15 volts or more in amplitude, and ten milliseconds or more in duration. The pulse may be obtained from an external pulse circuit or by momentarily shorting pin 44 of J-1 to pin 13. See Figure 2.

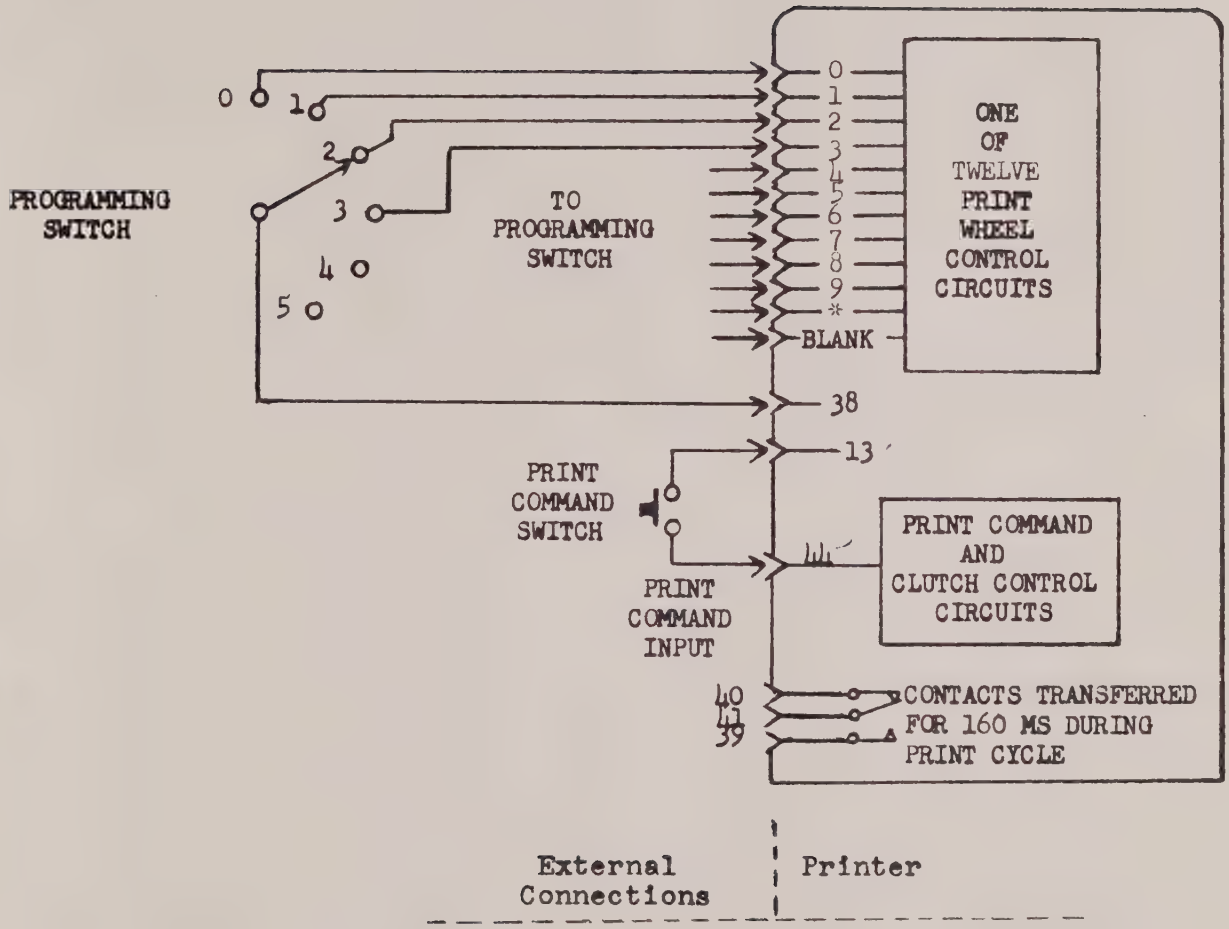


Figure 2. External Programming

4.4 Disable Relay

Accurate print wheel positioning requires that the data source be prevented from changing number selections during the printing cycle. Relay K-1 is included to disable external number selecting circuits. The relay is energized at the beginning of the printing cycle. The external number selecting circuit can be disabled during the printing cycle by connecting its supply voltage through the normally closed contacts of the relay. Terminal numbers are given in Figure 2. This closure also serves as a "print complete" signal to external equipment.

4.5 Multiple Data Sources

Successful data recording from two or more sources requires that the data sources be timed or synchronized in such a way that data from each source is ready for printing when the 155 receives a print command signal.

It is important that the entire system external to the 155 operates so that every data gathering source selects and holds data which is fed to the 155. Each data source must continue to hold its data output until the completion of the 155 printing cycle.

After each data source has presented a fixed data selection to the 155, some element of the external system must provide a print command signal to the 155.

CAUTION

The common line of the Model 155 is a floating ground. It assumes the potential of any source to which it is connected. Use caution when connecting several data sources to the common line.

5.0 THEORY OF OPERATION, AND MAINTENANCE

Accompanying this document is the Hewlett-Packard Operating and Service Manual for the Type 130 Printer Mechanism. This manual is fully applicable to the Model 155 printer except as listed below.

Page 5-1

Paragraph 5-2 Ordering.

All parts for the Model 155 Printer may be ordered from Non-Linear Systems, Inc., Del Mar, California. Parts whose numbers are prefixed by 15026- or 15069- may be ordered from NLS only. All other parts may be ordered from NLS or Hewlett-Packard.

Page 5-4, Table 5-2		Part Number
First thru Fifth lines	(Printer Mechanism, complete) Delete in entirety.	
Item 1	Panel Handle Total Quantity is 2.	
Item 2	Delete in its entirety and substitute:	
	Main front panel, door only	15026-019A
	Door including hinge pins	15026-019B
Item 5	Panel, paper drawer (less pin and spring)	15026-021
Item 11	Delete and substitute:	
	Upper Panel, standard	15026-022
	Upper Panel with NLS trademark (used on special units which have digital clock, recorder, or other accessory installed in left side of cabinet)	15026-002

Pages 5-8 and 5-9, Table 5-4 and Figure 5-3

Delete. (These parts are not used in Model 155.)

Page 5-10, Table 5-4		Part Number
Item 1	Delete and substitute:	
	Wheel bank assembly:	
	Printers with serial numbers 15.370 thru 15.373, 15.376 thru 15.514, 155.1 and subsequent:	
	Format #1 (See page 6 of Document No. 317)	15026-112D
	Format #2	15026-119D
	Format #3	15026-106D
	Format #4	15026-109D
	Special Formats--add "D" to number of format drawing supplied with printer--i.e. Format 15026-108	15026-108D
	Printers with serial numbers 15.375, 15.374, 15.369 and previous:	
	Format #1	15026-112C
	Format #2	15026-119C
	Format #3	15026-106C
	Format #4	15026-109C
	Special Formats--add "C" to number of format drawing supplied with printer--i.e. Format 15026-108	15026-108C
Item 8	Delete and substitute:	
	Print wheel and brush (See note below)	
	X, Y, or Z wheel (See page 6 of Doc. 317)	15026-015-7B
	S_1 wheel	15026-015-3B
	S_2 wheel	15026-015-6B
	Special Wheels--order by symbol arrangement and Format drawing number; i.e. "Wheel with symbols BCDEFGHJKAML used in column 11 of Format 15026-107" or request NLS Drawing 15026-015, which lists all print wheels used in Model 155 Printers.	
Item 10	Delete and substitute:	
	Commutator Card (See note below)	
	Printers with serial numbers 15.370 thru 15.373, 15.376 thru 15.514, 155.1 and subsequent:	

Page 5-10, Table 5-4 (cont.) — Part Number

Item 10 (cont.)

Commutator Card, plain	15026-023B
Commutator Card with decimal point	15026-014D
Commutator Card with colon	15026-024D

Printers with serial numbers 15.375, 15.374, 15.369 and previous:

Commutator Card, plain	15026-023A
Commutator Card with decimal point	15026-014C
Commutator Card with colon	15026-024C

Note: Part numbers given are for the new NLS Gold Plated commutator cards and print wheels, incorporated in production effective in serial number 155.41. When replacing the older rhodium plated parts, both the commutator card and the corresponding print wheel should be replaced; operation of rhodium plated print wheel brushes on gold plated commutator cards, or gold plated brushes on rhodium plated cards, is not recommended.

Item 20 — Delete and substitute:

Print wheel gear, 29 tooth	560A-24F

Item A — Setscrew, 6-32 x 3/16 in. Total Quantity is 4.

Page 5-12, Table 5-4

Item 25 — Delete in its entirety and substitute:

Connector assembly (includes 11 connectors and screws, unwired)	15026-020

Items 26 thru 31, and Items A and B — Delete. (These parts are not used in Model 155.)

Page 5-18, Table 5-7

Item 4 — Delete "Shutter, scan, Part No. 562A-83A" (This part is not used in Model 155.)

Page 5-20, Table 5-8		Part Number
Item 1	(Pawl magnet assembly, complete) Delete.	
Item 6	Magnet Coil	9161-0009
Item 12	Print idler bearing	560A-17Z
Item 25	Clutch solenoid	0491-0007

(End of differences to H-P 130 Manual)

ELECTRICAL PARTS LIST

Item	Description	Part Number	Total Quantity	Manufacturer
1	Circuit Board Assembly, complete (includes Items 2 thru 20 below)	15026-013	1	NLS
2	Transistor	3689	11	RCA
3	Transistor	2N651	1	
4	Transistor	2N457	1	
5	Rectifier	1N2616	8	
6	Diode	5003-002	11	NLS
7	Resistor, 270 ohm, 10%, ½ W		1	Ohmite
8	Resistor, 1000 ohm, 10%, ½ W		11	Ohmite
9	Resistor, 3300 ohm, 10%, ½ W		1	Ohmite
10	Resistor, 5600 ohm, 10%, ½ W		1	Ohmite
11	Resistor, 6800 ohm, 10%, ½ W		1	Ohmite
12	Resistor, 18K ohm, 10%, ½ W		11	Ohmite
13	Resistor, 56K ohm, 10%, ½ W		1	Ohmite
14	Resistor, 2.7 ohm, 10%, 1 W		1	Ohmite
15	Relay, 2PDT, 28V	RP7641G2 or RP9003G1	1	C.P. Clare
16	Transformer, power	15026-002	1	NLS
17	Capacitor, 500 mfd, 50 V	05RTK500	1	Industrial

ELECTRICAL PARTS LIST

Item	Description	Part Number	Total Quantity	Manufacturer
18	Capacitor, 0.47 mfd, 200 V	MW44M2474	11	Westcap
19	Cable clamp	EC-8	1	
20	Connector	57-30360	1	Amphenol
	Items 21 thru 29 are located on the printer mechanism.			
21	Lamp	1829	2	
22	Resistor, 82 ohm, 10%, 2 W		2	Ohmite
23	Fuse, 0.6 Amp	313.600	1	Littelfuse
24	Rectifier	1N2616	1	
25	Connector	57-40360	1	Amphenol
26	Capacitor, 2 mfd, 600 V	17-53	1	H-P
27	Switch, cam-operated	310-208	1	H-P
28	Switch, toggle, "Record"	310-215	1	H-P
29	Switch, toggle, "Power"	310-11	1	H-P
	Items 30 thru 33 are located on the rear panel of the printer.			
30	Connector	57-40500	3	Amphenol
31	Line Cord	1002-028	1	NLS
32	Fuse Holder	342004	1	Littelfuse
33	Fuse, 1.25 Amp	3131.25	1	Littelfuse

ELECTRICAL PARTS LIST

Item	Description	Part Number	Total Quantity	Manufacturer
	Items 34 and 35 are supplied with, but not attached to, the printer.			
34	Connector	57-30500	3	Amphenol
35	Hood assembly (holds two of Item 34 to fit J1 and J2)	561B-95H	1	H-P

NOTE

The following fold-out page is the schematic diagram of the NLS Model 155 printer. Special features and recent changes, if any, are shown on a seperate diagram shipped with the printer.

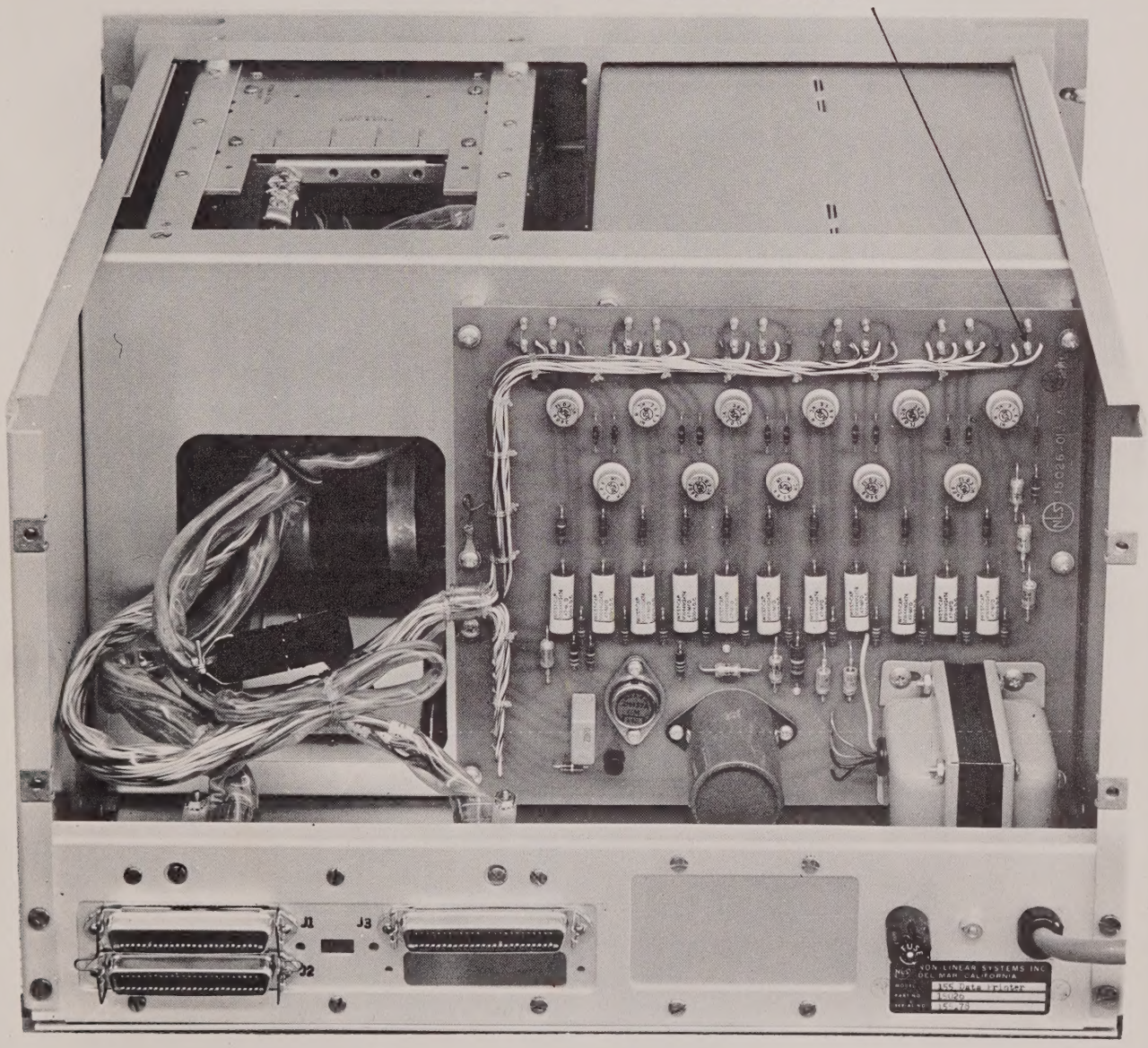
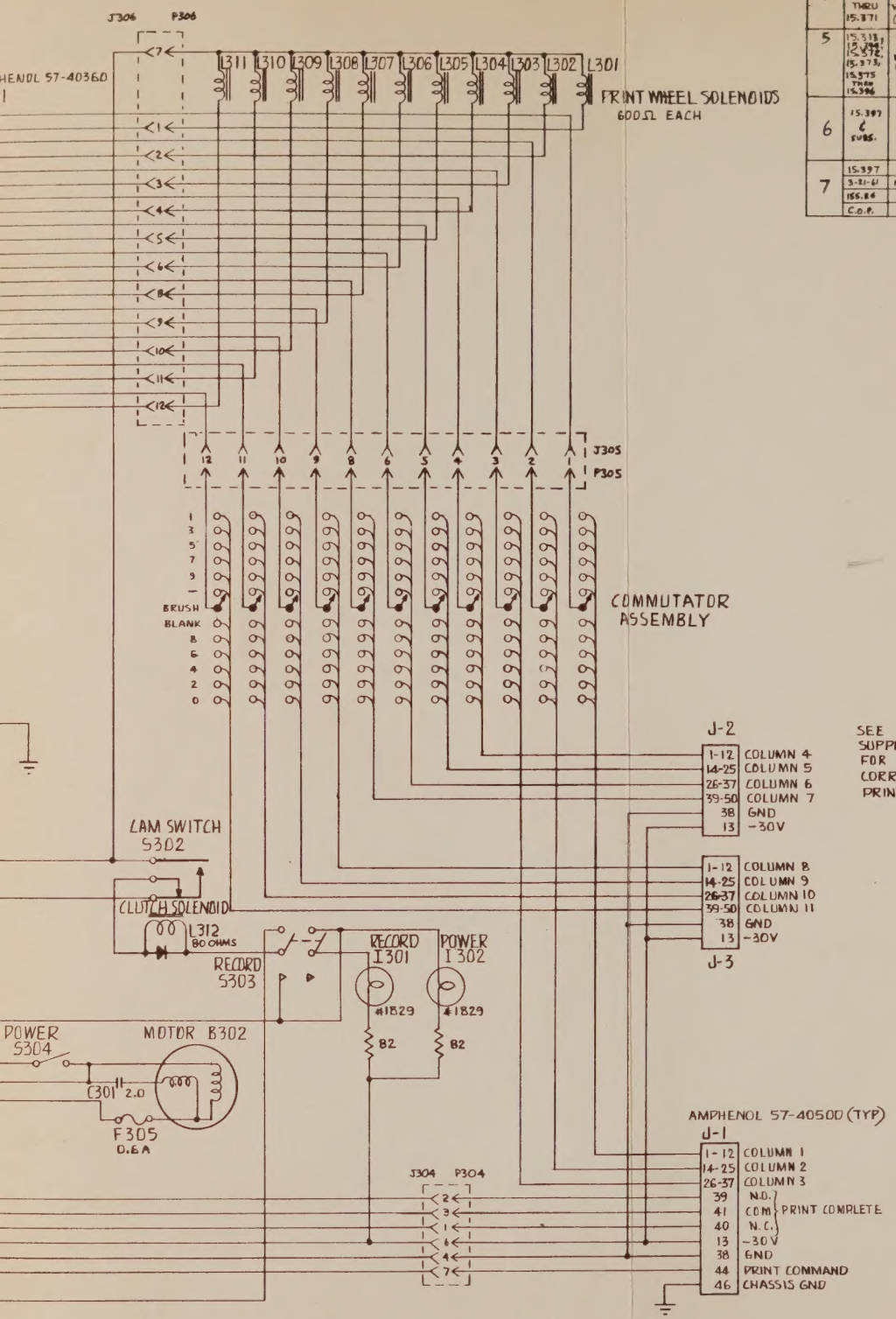


FIGURE 3. PRINTER, REAR VIEW

REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL
4	15.361 THRU 15.371	REVISED & REDRAWN WAS C SIZE. 8.2K WAS 15K (11 PLACES)	18 MAR 60 ARW	HH Soule H Clement
5	15.313, 15.344, 15.372, 15.373, 15.375 THRU 15.396	REVISED TRANSISTOR CIRCUITRY; EFFECT ON CHG 4 WAS "15.361 THRU 15.373, 15.376 & SUBS"	19 APR 60 ARW	H Clement May 8-60
6	15.397 & SUBS.	EFFECT. OF CHG 5 WAS "15.372, 15.373, 15.376 & SUBS." ADDED J305, P305, J304, & P306 REMOVED R & C ACROSS S302 REMOVED R ACROSS L312 (L312 was L12)	8-3-60 HH	H Hallert 8-3-60
7	15.397	ADDED J304 & P304	1-26-62	H Hallert
	3-21-61	NLS 5003-002 WAS IN34A		
	155.84	ADDED GND. CONN. TO PIN 22 OF J301		
	C.O.P.	IN2616 WAS IN2071		



SEE FORMAT DRAWING SUPPLIED WITH PRINTER FOR PIN CONNECTIONS CORRESPONDING TO PRINTED SYMBOLS

15026 SH 2

7

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTION ± DECIMAL ± ANGLES ±
MATERIAL

DRAWN BY K.D. LANGLEY	DATE 9-26-58	
CHECKED BY H. HALBERT	DATE 9-29-58	
APPROVED BY H. CLEMENT	DATE 12-24-58	

FINISH

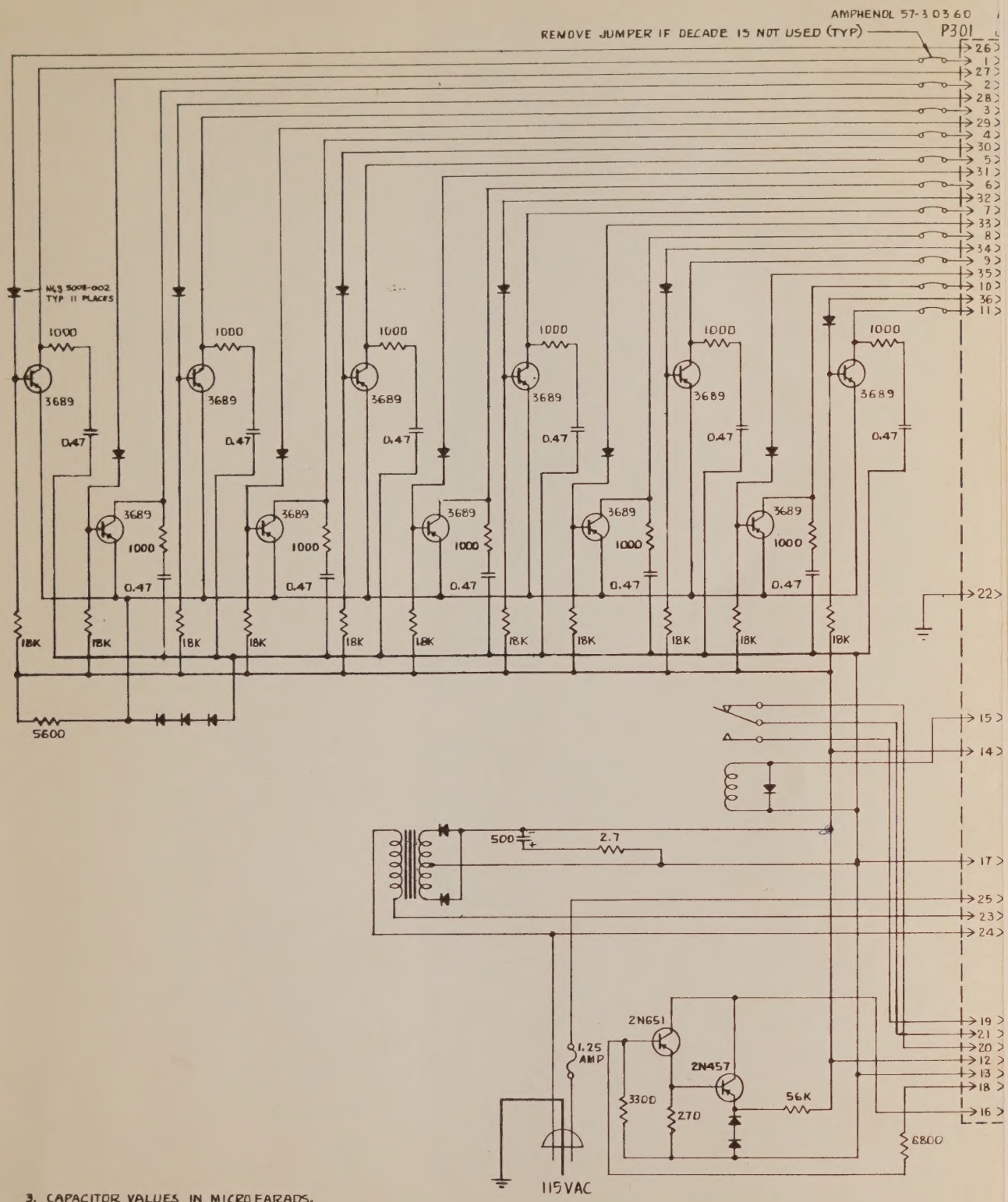
TITLE
SCHEMATIC-DATA PRINTER
MODEL 155

SCALE WT.

NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 15026

SHEET 2 OF



3. CAPACITOR VALUES IN MICROFARADS.

2. RESISTOR VALUES IN OHMS.

1. DIODES ARE SILICON JUNCTION, TYPE 1N2616 OR EQUIVALENT.

NOTES: UNLESS OTHERWISE SPECIFIED